

## Nanotechnology and Lifestyle

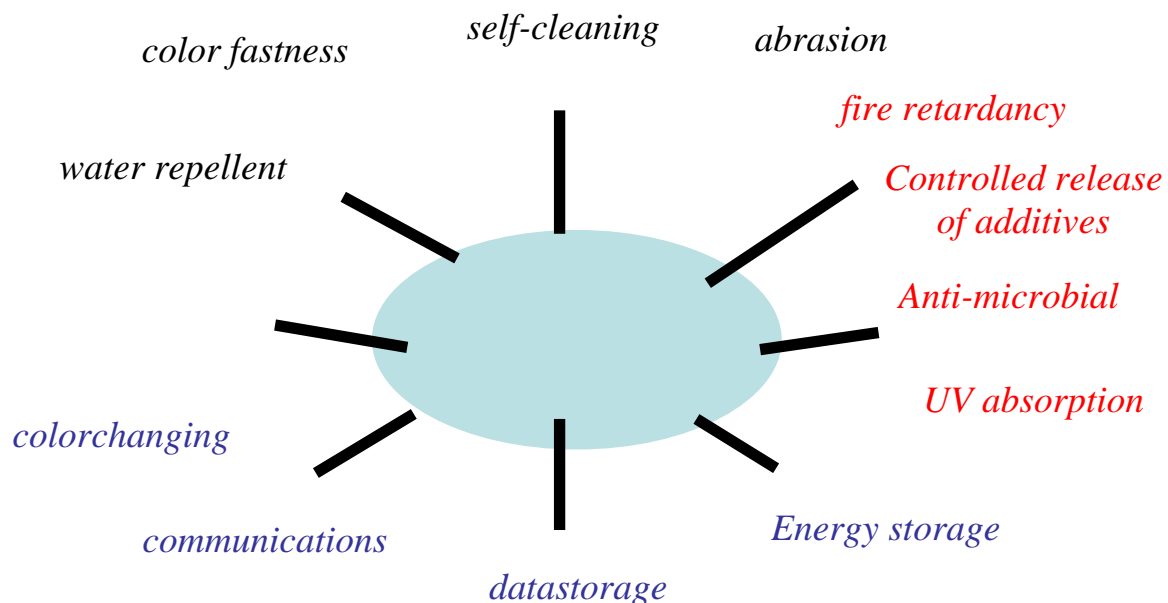
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### Introduction

Perhaps surprisingly the earliest commercialized applications of nanotechnology are seen in lifestyle applications. Textile, sports and cosmetics are among the first products to use nanomaterials. This overview discusses these and other examples of nanotechnology materials and technologies in lifestyle applications.

### Textile

Treating textiles with nanotechnology materials is a method to improve the properties of the textile, making it longer durable, have nicer colours etc. Nanotechnology can also be used to add new functionalities like energy storage and communications. The next figures show some of the opportunities offered by nanotechnology to improve the functionality of textiles.



**Figure 1: Improved and new functionalities of textile by nanotechnology.**

Some interesting examples of nano improved textiles currently on the market are:

- Stain repellent and wrinkle-resistant threads woven in textiles
- Bodywarmers use Phase Change Materials (PCMs) responding to changing body temperatures.
- Nanosocks treated with silver nanoparticles. The silver acts against infection and odour.

Bulletproof vests are another item profiting from nanotechnology. Nanotube fibers are used to make a material seventeen times tougher than the Kevlar.

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Future developments are to use nanotechnology to create Smart and Interactive Textiles (SMIT) that can sense electrical, thermal, chemical, magnetic, or other stimuli. For instance a shirt that makes it possible to remotely monitor a wearer's movement, heart rate, and respiration rate in real-time through a conductive fiber grid that is seamlessly knit into the material.

### **Cosmetics**

At the forefront of nanotechnology in cosmetics we see companies like l'Oreal, producing anti-wrinkle cream containing nanocapsules, which help active ingredients get to the skin's deeper layers. By reducing the active ingredients to a very small size and coating them with a biodegradable polymer, the company found the nanocapsules were small enough to pierce through the first layers of the skin and release the active ingredients below, in the lower layers of the skin.

Anti dry skin crèmes use oxide powder with nanosized silica powder. Zinc oxide nanoparticles scatter the light, thereby protecting the skin. Besides that, ultra-fine titanium dioxide with the inclusion of a small amount (<1%) of manganese can catalyse free radicals that have been generated by other sunscreen components into harmless chemical species.

### **Sport**

Even small improvements in material properties can be crucial in sports. Not surprisingly sport articles are a popular testing bed for nanotechnology. Some examples:

- A hockey stick based using carbon nano tubes, to combine carbon fiber and epoxy on the molecular level in a new way and realising
- Tennis balls containing hundreds of nanodispersed platelets per micron of coating thickness forming a tortuous path for gas molecules thereby increasing the barrier properties.
- A ski wax containing nanoparticles organizing themselves on the surface automatically. Therefore they have a high amount of fluorine at the surface and uniform distribution.

### **Self cleaning and user adaptable surfaces**

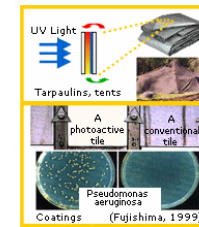
The leaves of certain plants and the wings of insects always stay clean because dirt and water cannot adhere to their structured surface. The lightest rainfall can therefore clean the surface. Learning from that observation, several nanostructured top layers have been proposed and are applied to create self cleaning surfaces.

Electro-chromic materials, another example, are able to change between a transparent and an absorbing state through the application of a low voltage (only a few volts). A foil consisting of thin oxide layers is laminated between two flexible polymer sheets. The foils are first coated with a transparent electrically conducting layer and then by active electro-chromic layers. The user can easily control the transparency using an electronic control unit. The visor changes between dark and light conditions in a few seconds.

Nanocoatings can even be used as ski-wax. The ultra thin coating changes according to the temperature and adapts to the surface and snow-crystals. The surface structure remains completely free of wax enabling optimum gliding.

Other examples of nano surface coatings are:

- Titanium dioxide (TiO<sub>2</sub>) crystals, only 40 nanometers in size, formed to a layer and acting as a powerful oxidizing agent, destroying airborne germs and pollutants.
- A aqueous suspension, applied via roll (or dip, or spray) coating process onto a substrate forms a tortuous path for molecules such as oxygen and aromatics. This increases the barrier properties of the substrate and makes the materials more air tight. Is being now introduced in tennis balls.



# Nanotechnology and Lifestyle

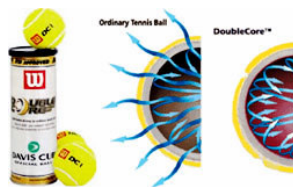
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The jacket is fitted with a sensor and a Bluetooth transmitter that communicates with a receiver.



# Mission Statement enablingMNT

- enablingMNT represents a group of independent experts, with industrial experience, who can be contracted to help organizations with the commercialization of their *Micro and Nanotechnology* developments and ideas.

# Further Reading ...

**enablingMNT Industry Reviews are available at € 280 each:**

[Foundries for MST/MEMS](#), Nov 2005

[Processing Service Suppliers for MST/MEMS](#), May 2005

[Test and Measurement Equipment and Services for MST/MEMS](#), Dec 2004

[Suppliers of Materials for MST/MEMS Production](#), Sep 2004

[MNT Web Directories and On-line Communication Channels](#), Aug 2004

[Equipment Suppliers for Nanofabrication](#), Apr 2004

[Back-End Manufacturing Equipment Suppliers for MST/MEMS](#), Nov 2003

[Front-End Manufacturing Equipment Suppliers for MST/MEMS](#), Nov 2003

[Packaging & Assembly Services for MST/MEMS](#), Oct 2003

Reviews under preparation (information is available on request):

[MST/MEMS companies in China](#)

[Design & Engineering Companies for MST/MEMS](#)

# Outline

- Textile
- Cosmetics
- Surfaces
- Sports
- Bionano
- Sensors
- Summary



# Nano- technology textile?

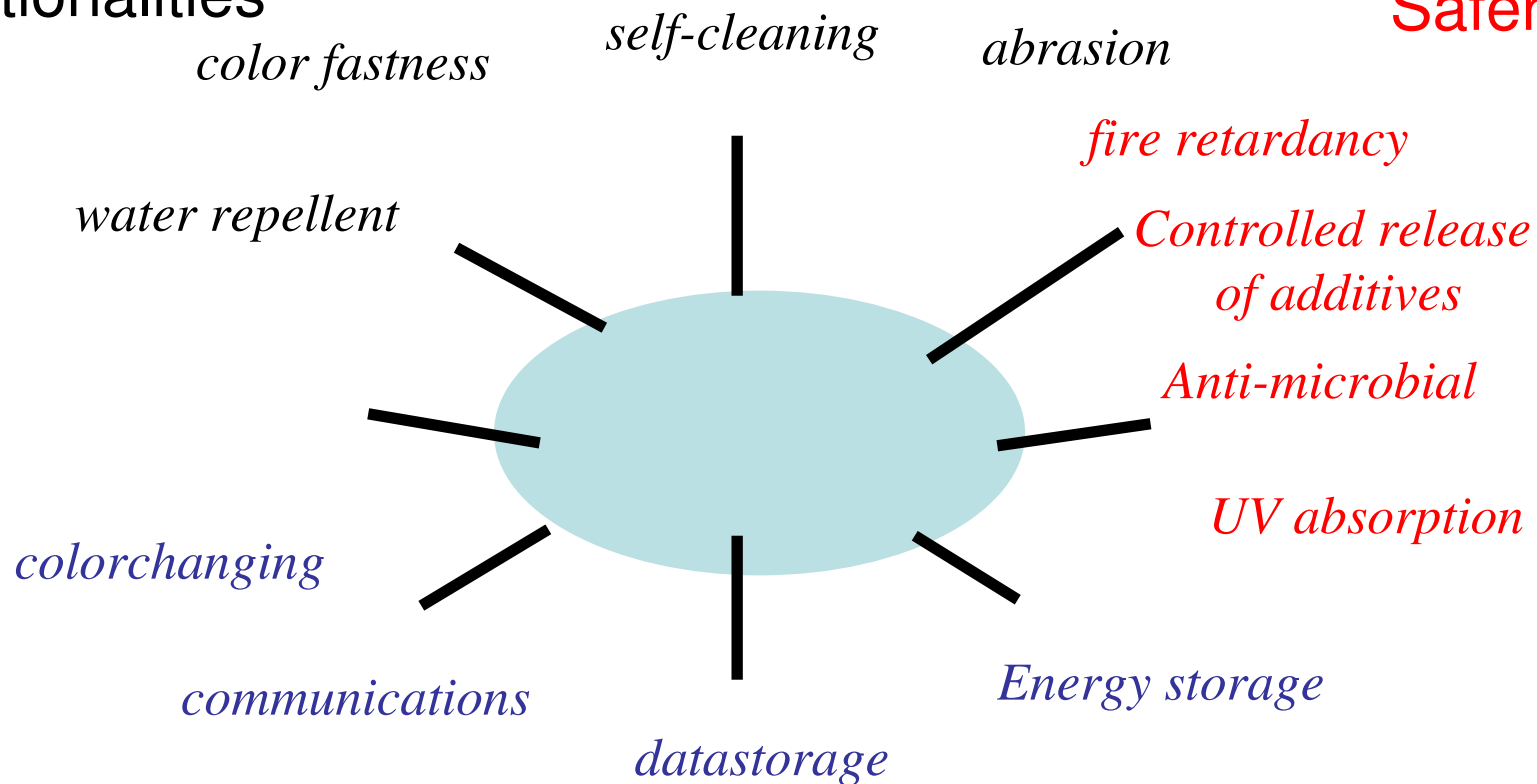
estyle, November 2006



# Textile applications of nanotechnology

Better  
functionalities

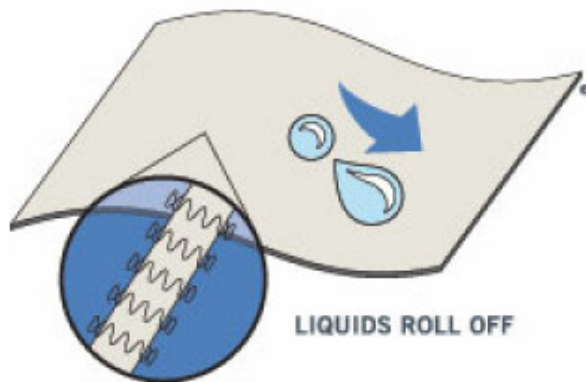
Safer



New  
functionalities

# Stain repellent and wrinkle-resistant threads

- Dockers (part of LeviStrauss) launched the Go Khaki with Stain Defender, uses Nanotex products
- Levi's uses a DuPont Teflon coating – the stuff of nonstick cookware –
- The benefits come courtesy of cotton or synthetic fibers engineered with whiskery molecules that repel oil and liquids or polymer “nets” that wick moisture away from the body



ren, enablingMNT, nano & lifestyle, November 2006

# Anti odor (Nano-Tex/ARC Outdoors)

- Nano-Tex: The next product is already on deck – Nano-Fresh contains molecular-scale sponges that soak up and neutralize stinky-odor-causing hydrocarbons and release them only when washed.
- ARC Outdoors: anti odor fabrics for cold weather clothing; improvement to have the particles inside the fiber instead of on the surface: not flaked or rubbed off or washed off.

# Nanosocks

- Even your socks can benefit from a nanotech upgrade. London-based JR Nanotech's SoleFresh socks are peppered with silver nanoparticles.
- Silver's natural antibacterial and antifungal properties mean that the socks combat infection, sores, and, yes, stinky feet.
- SoleFresh socks would go well with underwear sewn with Sensory Perception Technologies (SPT), a fabric developed by ICI and The Woolmark Co.
- The companies developed a process to bind tiny melanin capsules, bulging with perfumes or moisturizers, to textiles. As the capsules burst over time, the sweet smell, insect repellant or deodorant inside is released.

# Nanosocks (JR Nanotech)

**SoleFresh™**  
**Nano-silver Socks**  
[Click to purchase now](#)

- **SoleFreshT contains 0.3%w/w nano-silver**
- Eliminate foot odour
- Curing Athlete's Foot
- Prevent foot infection in patients with diabetes
- Keeping feet dry and fresh
- **Colour Black only**
- 80% Cotton
- 20% Elastic yarn
- Contains 0.3%w/w nano-silver
- **Sizes**
- M101-L Large for shoe size 7 and under
- M101-XL Ex-large for shoe size 8 and above
- M106 Ankle socks one size
- Nano-silver content is guaranteed up to 50 washes
- **Price**
- £5.00 for Two Pairs (Inclusive of postage and package in UK)



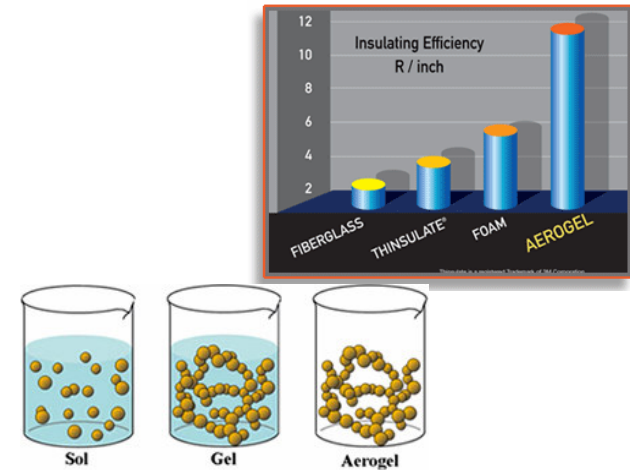
# Other bachelors dreams

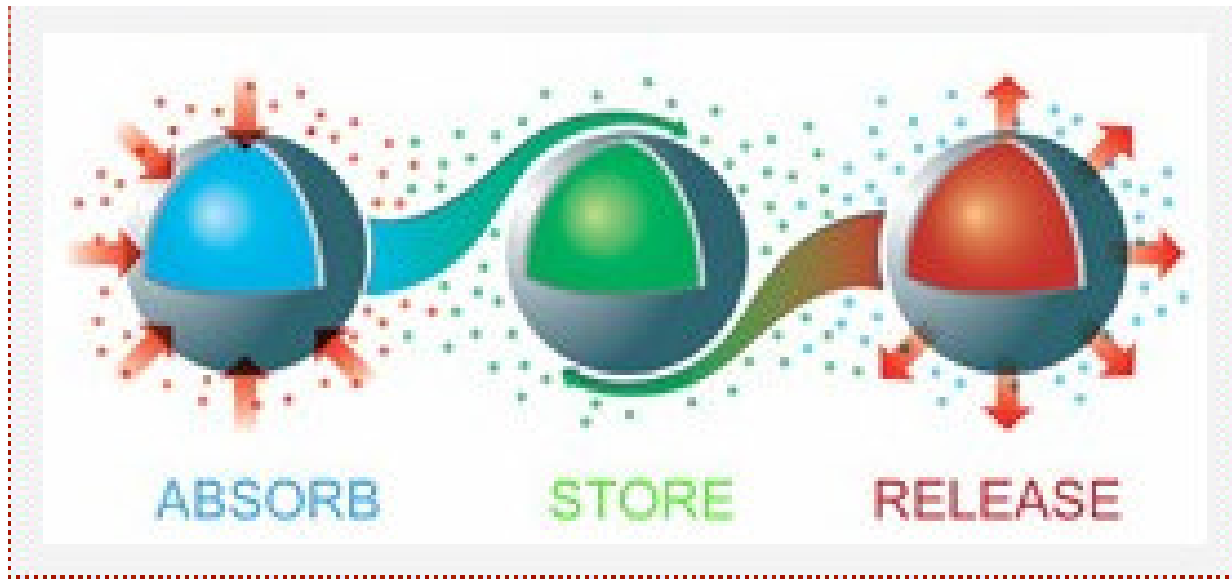
- Nano washing machine (Samsung)
  - Jets of cold water with nano silver particles created by pashing two silver electrodes
  - Keeps the cloths fresh for up to 30 days
- Sealants repelling oil, water etc on marble, granite, limestone etc etc. Applicable with spray brush or roller. (Sealguard)

# Bodywarmers etc

(Invista, Outlast Technologies, ToastyFeet)

- ToastyFeet/Aspen Aerogel: 5% sheets of fiber, rest air in nanometer sized pockets
  - Also to be used for isolating undersea oil pipes and for astronaut suits
- Phase Change Materials (PCMs) respond to your changing body temperature.
  - The fabric coating consists of the materials encapsulated into microscopic spheres.
  - As your body warms up, the PCM melts, drawing the heat away from you.
  - Once you cool off, the PCM freezes again, in turn releasing its stored heat to keep you cozy. And on and on.
  - Originally developed for astronauts.



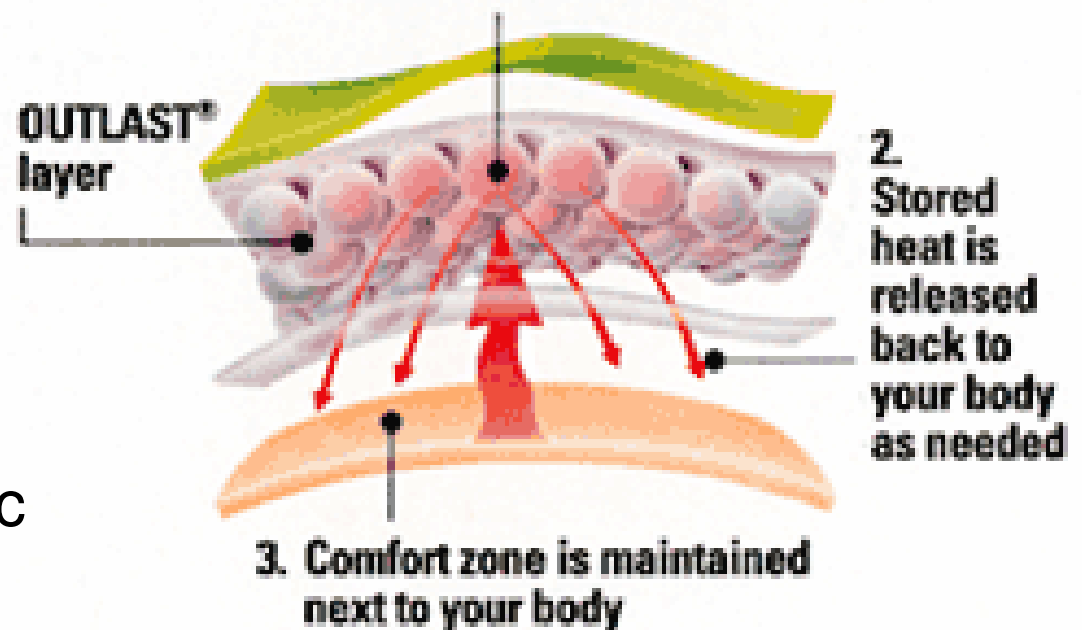


Thermocules, a  
phasechange  
material

Outlast Technologies, Inc

Nato lectures, Henne van Heeren, enab

**1. Excess heat generated by the body is absorbed into the OUTLAST® Thermocules® PCM**



Textile



# Smart and Interactive Textile (SMIT)

- SMIT's can sense electrical, thermal, chemical, magnetic, or other stimuli
- SMIT's can adapt themselves to those stimuli
- Major part low tech products like photochromic t-shirts
- New functional textiles by combination of textiles and electronics:
  - Communication
  - MP3-player
  - Mobile telephone
  - Monitoring
  - Heart beat, performance
  - Body functions
  - Safety
  - LED's, chemical sensors, temperature, moisture
  - Gimmicks
  - Toys



The jacket is fitted with a sensor and a Bluetooth transmitter that communicates with a receiver.



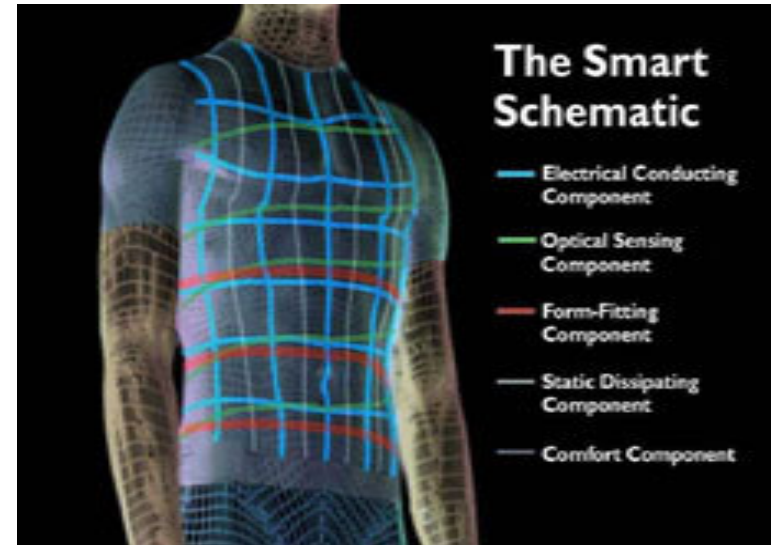
# SmartShirt System to monitor human vital signs remotely

## Sensatex: SmartShirt System:

The system makes it possible to remotely monitor a wearer's movement, heart rate, and respiration rate in real-time through a conductive fiber grid that is seamlessly knit into the material of the fully washable shirt.

## Possible uses:

- home health monitoring for the elderly
- observing outpatients in post-operative and chronic illness situations
- training support for athletes
- remote monitoring for first responders, hazard materials workers and soldiers in the field
- watching professional truck drivers' vital signs to alert them of fatigue.



# Smart shirt and smart bra

- Currently it is offered by VivoMetrics monitor patients with a respiratory disturbance called sleep apnea.
- A future variant worn by chronically ill patients at home could extend their lives by enabling doctors to better monitor their health and to intervene faster when trouble arises.
- Sensors in the uniform would detect fractures, uncontrolled bleeding or the soldier's collapse, helping medics to treat first those who need help the most.
- The main innovation of the sports bra, made by NuMetrex is the conductive fabric. The transmitter and the wrist monitor are sold separately. The transmitter snaps into a pocket in the front of the bra -- and out for machine washing.
- NuMetrex aims at the sport market to monitor respiration, the proportion of lung capacity used, length of stride and other indicators vital to athletes.
- A T-shirt version for men is planned for next year.





Your foot  
is telling  
you  
where  
you are!!!  
(or tell the  
taxi driver  
where  
you are!)

# Bulletproof vests?

- In a Nature article published last year, researchers at the University of Texas at Dallas and Trinity College Dublin described success with continuous spinning of carbon nanotube fibers.
- Seventeen times tougher than the Kevlar used for bulletproof vests, the fibers are twice as strong as steel wire of the same weight and length.
- The fiber could be used to weave clothing that's not only bulletproof but might also store electrical energy like a battery.
- **But:**
- You're not only trying to stop the bullet but have to reduce the energy transmitted to the body locally also.
- Research is working on a shield made of a polymer composite using carbon nanotubes. As shrapnel or bullets hit the ballistic shield, the nanotubes closest to impact pull apart, absorbing the energy and protecting the flesh.

# Consumer products account for the bulk of Smart and Interactive Textiles (SMIT) sales 2003-2009,

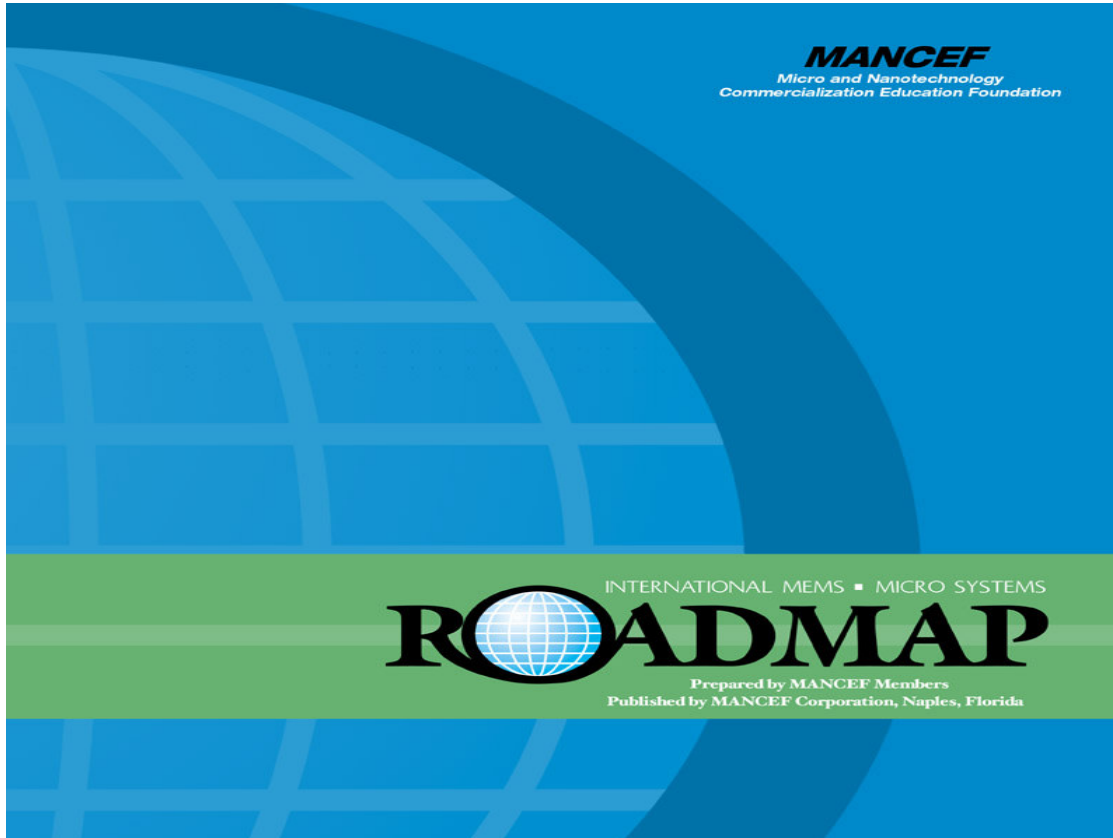
Source: BCC, Inc, Norwalk Conn.

Application segment	2003 (M US \$)	2004 (M US \$)	2009 (M US \$)	AAGR % 2004 - 2009
Military	1,5	1,5	25,5	76,2
Biomedical	0,235	0,78	66,2	143,1
Homeland defense/public safety	-	-	15,0	-
Vehicle safety, comfort	-	-	54,0	-
Computing	1,9	2,0	4,2	16,0
Logistics, supply chain management	-	-	1,0	-
Consumer products	57,5	60,1	122,2	15,2
Other	-	-	11,2	-
Total	61,135	64,38	299,3	36,0





# Mancef Roadmap



## Scope:

- The current status of the technology and innovation
- The practices that will reduce risk and improve MEMS commercialization
- Technology and manufacturing trends over the long term ( i.e. roughly 5-10, 15 - 20 years from now)



# Top Nano IPC Categories



Subclass	IPC	#	IPC Code Description
C01B	031/02	456	Preparation of carbon
C12Q	001/68	340	Measuring or testing processes involving nucleic acids
B82B	003/00	289	Manufacture or treatment of nanostructures
H01J	009/02	242	Manufacture of electrodes or electrode systems
A61K	007/00	227	Cosmetics or similar toilet preparations

Till march 2005: More than 3800 US nanotechnology patents have been issued and another 1777 patents applications are pending.

# Top Patentees



Rank	Assignee	Doc
1	L'Oreal (cosmetics)	266
2	International Business Machines (IBM) (technology)	125
3	Regents of the University of California	107
4	Eastman Kodak Company (photo images)	84
5	Massachusetts Institute of Technology (MIT)	79
6	Henkel Kommanditgesellschaft (home/pers. Care)	76
7	Japan S&T Corp (government-sponsored agency )	76
8	BASF Aktiengesellschaft (Chem/mat)	66
9	Allied Signal (chem/mat., now part of Honeywell)	65
10	Micron Technology, Inc. (semiconductors)	62

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# Anti dry skin (Shiseido)

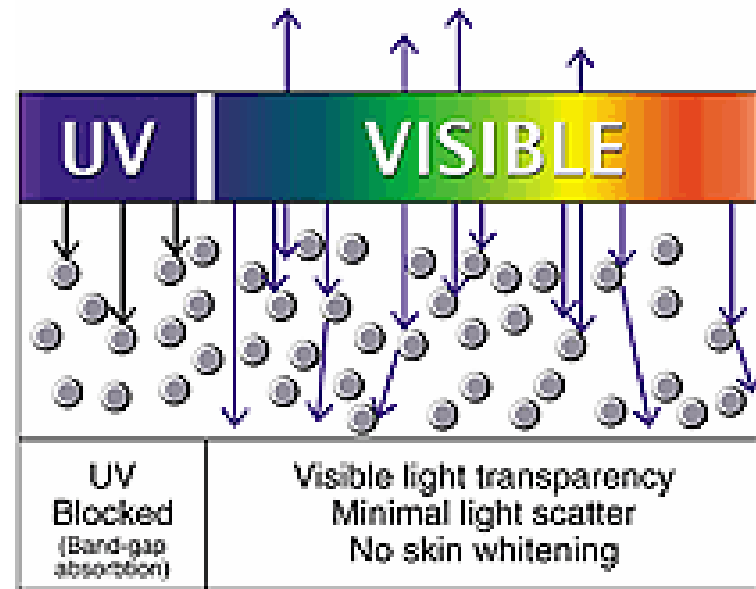
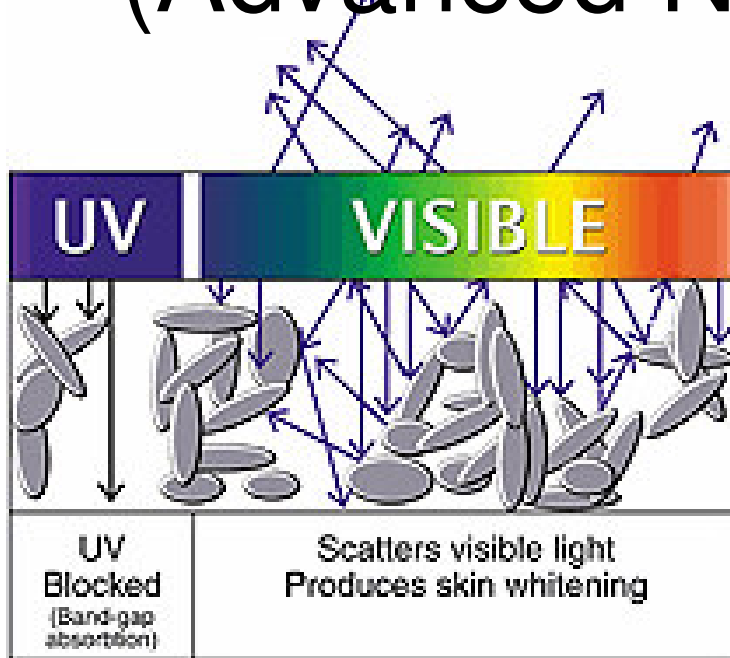
- Combination of oxide powder with silica powder (talc) at the nano-order level.
- An inorganic powder could restrain enzymes leading to dry skin.
- Shiseido's first product, Elixir Skinup, debuted in March 2001 and reportedly sold around 1.4 million units in its first year





- Plenitude line of cosmetics contains nano-capsules, which help active ingredients get to the skin's deeper layers.
- The active ingredients are reduced to a very small size and coated with a biodegradable polymer.
- The nanocapsules were small enough to pierce through the first layers of the skin.
- The skin's enzymes eat at the surface of the nanocapsule and release the active ingredients in the lower layers of the skin
- On the market since 1995.

# UV blocking (Advanced Nanotechnology)



Cosmetic clarity and the efficiency of zinc oxide in blocking UVB and UVA is directly related to particle size, size distribution, particle loading and dispersion. Whitening in sunscreens and cosmetics is a result of visible light scatter produced by large particles and poor dispersion.

Nato lectures, Henne van Heeren, enablingMNT, nano & lifestyle, November 2006

# Sunscreen (Oxonica)

- Many sunscreens rapidly lose their effectiveness over time, as the components are broken down by sunlight. Besides free radicals are created by UV light and are a major cause of skin ageing and damage.
- The oxonixa product (used in [Optisol™](#)) is based on ultra-fine titanium dioxide with the inclusion in the crystal of a small amount (<1%) of manganese.
- This causes a reconfiguration of the crystal's internal electronic structure that allows absorbed UV energy to be dissipated, virtually eliminating the generation of free radicals. The manganese acts as a free radical scavenger.
- The addition of manganese also changes the white color of the titanium dioxide to a more natural skin color tone. Consumers, who have tried [Optisol™](#) based sunscreens, have reported a 'natural glow' effect when applied to the skin.

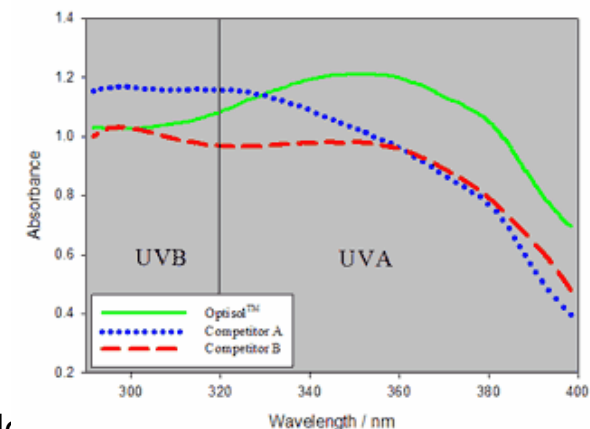


Figure 1: OPTISOL Absorption Profile Compared to Competitor Materials

Cosmetics

# Recent launches of nano based cosmetics

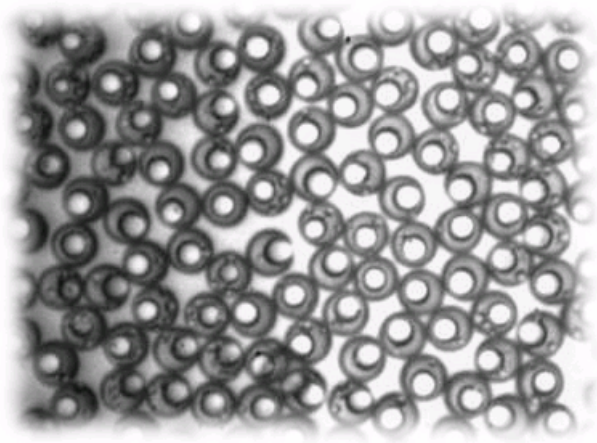
- Recently L'Oreal launched its High Intensity Pigment color cosmetics line – only instead of featuring its nano particle-based formulation, the company shyly refers to it as 'photonics'.
- At the same time four products have been launched In Japan, including a lucent facial powder and a moisturizing liquid, both from Ishizawa, as well as a Primordiale Nanolotion from Lancome and a Nano Callogen lip moisturizer from Isehan.
- For all the products the stress is on the fact that the nano particles allow them to be spread more evenly over the skin.
- Doctor Cosmetic Lab is launching a non-chemical sunscreen in Thailand, under the Smooth E brand that also includes a nano complex of  $\text{TiO}_2$  and  $\text{ZnO}$ . This formula is said to help prevent wrinkling caused by sun exposure as well as providing UVA/UVB protection.
- Germatika Ageless Cream is a 50 gram pot of anti-aging cream that features nanotechnology. It was launched on the Malaysian market back in October last year.



# Artificial Skin Layer for Premature Babies (Proctor & Gamble)

- A bio-based, self-assembling nanoparticle, which only a few years ago was being explored by Procter & Gamble Co. for use in over-the-counter cosmetics now holds a future – creating new skin treatments for premature infants.
- The cubosomes, as they are called, permit a ‘breathing layer’ for skin at the nano-level, thanks in part to cubosomes’ bicontinuous structure of oil and water interweaved together but never crossing each other,
- So unlike Vaseline, which forms a protective barrier layer over your skin, cubosomes can both protect skin from outside elements AND at the same time let the skin ‘breathe’ and exchange moisture with its environment.

# Less fat, more air or water

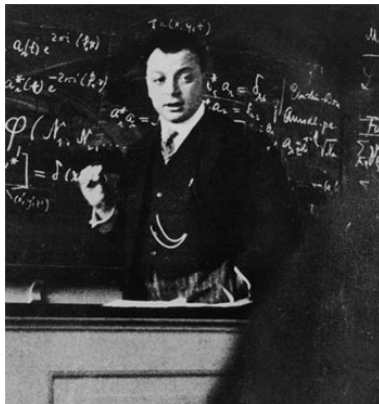


Nanomi produces with their membrane emulsification technology microbubbles with a monodisperse size distribution or double emulsions.

# *Gastric pacemaker*

- Intrapace is developing an endoscopically delivered gastric pacemaker for obesity treatment. (based on a TI chip).
- Pil sends electrical pulses creating a “full” feeling.

# The surface was invented by the devil

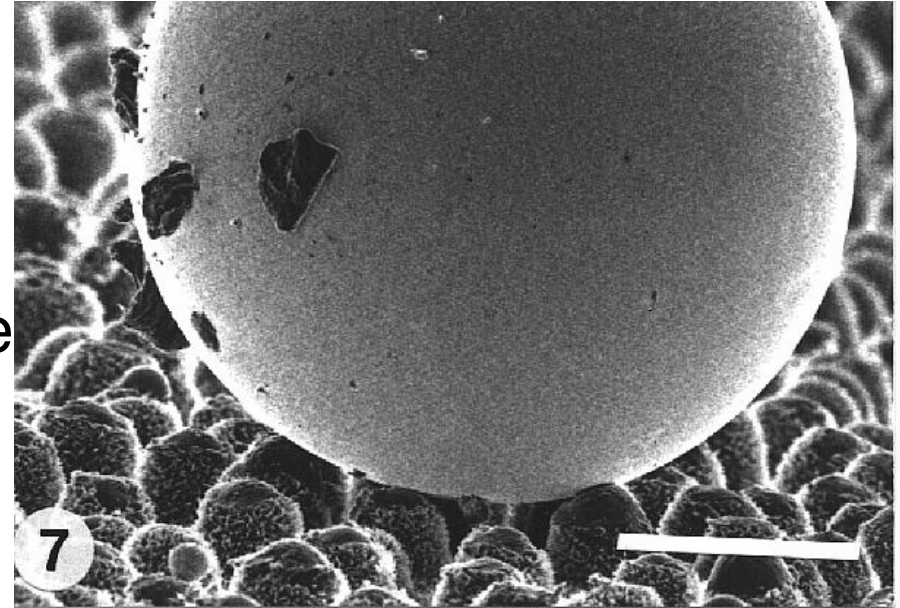


## Wolfgang Pauli

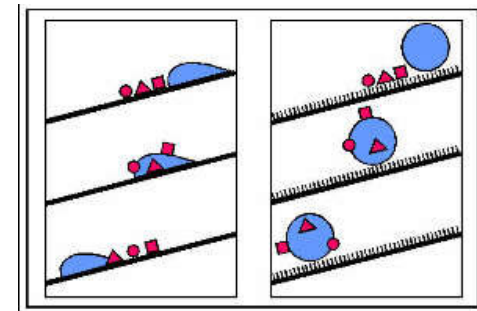
The surface is where most reactions take place

# Self cleaning surface (1) (University of Bonn)

- Mercury droplet on the adaxial leaf surface of *Colocasia esculenta* demonstrating the Lotus-Effect.
- Contaminating particles adhere to the surface of the droplet and are removed from the leaf while the droplet rolls off. Bar: 50  $\mu\text{m}$ .



On a smooth surface the contaminating particles are only moved by the water droplet (left). In contrast to that, on a rough surface they stick to the droplet rolling off the leaf thus being washed off (right).



# Self cleaning surface (2) (Schoeller textiles ag)

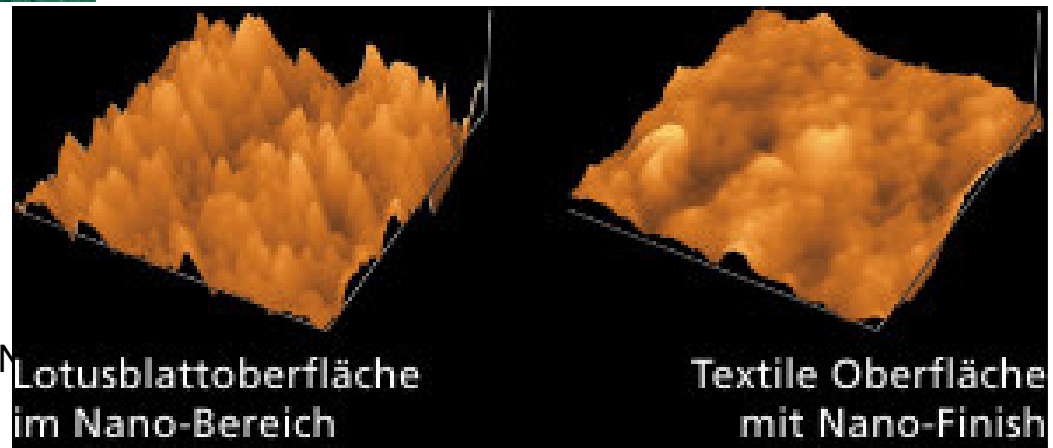
- Nature leads the way:



The leaves of certain plants and the wings of insects always stay clean because dirt and water cannot adhere to their structured surface.

Letting even the lightest rainfall clean the surface

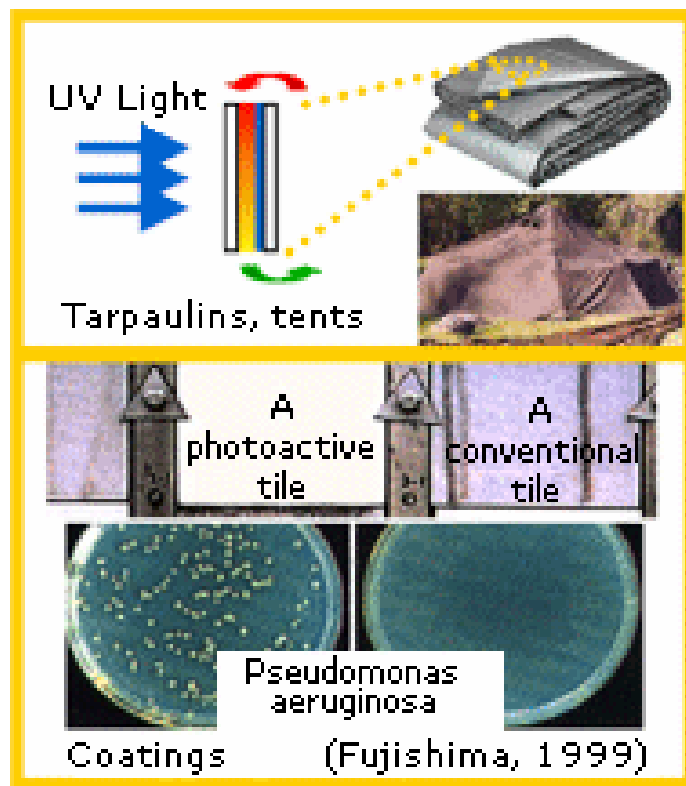
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Lotusblattoberfläche  
im Nano-Bereich

Textile Oberfläche  
mit Nano-Finish

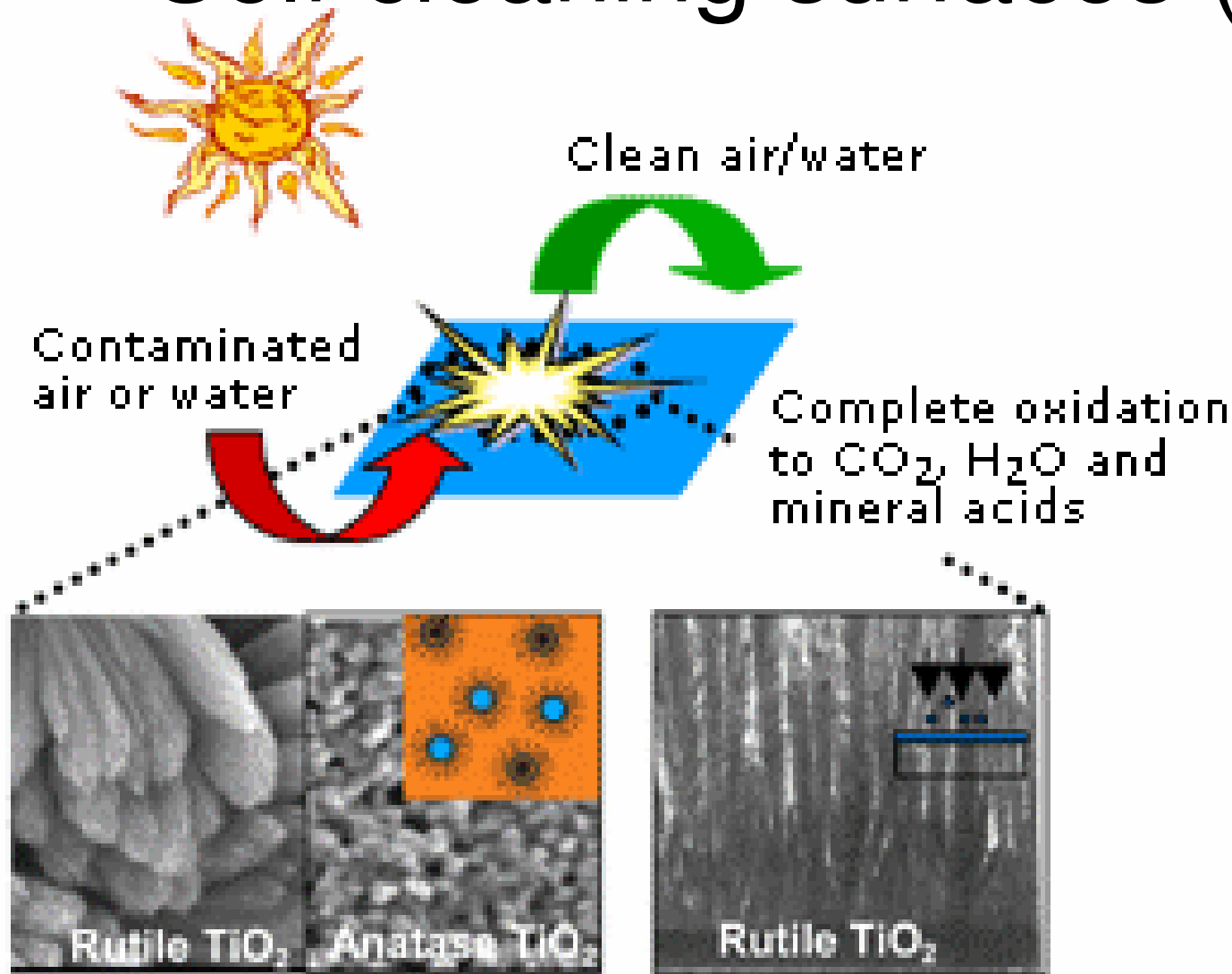
# Self cleaning surfaces (3) (Swedish defence)



Decomposition of surface layers such as dirt and bio-films on critical sensor surfaces and corrosion prone surfaces to obtain prolonged operational lifetime.

Flexible 2-layered membranes for air decontamination (warehouses, field hospitals, submarines and aircraft) and B/C-warfare agent decontamination (tent materials and tarpaulins).

# Self cleaning surfaces (4)



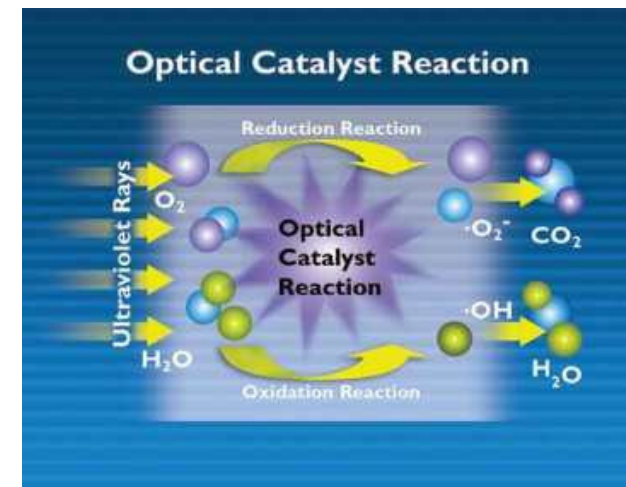
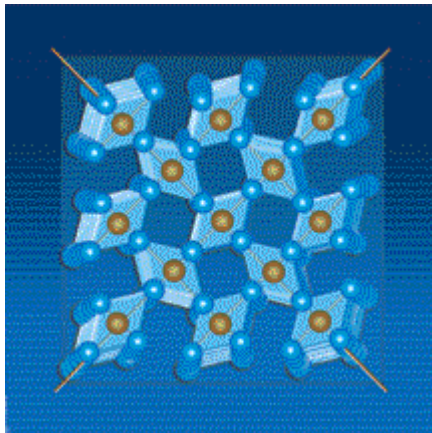
Microemulsions

Thinfilm technology



# Air purification (Nanobreeze)

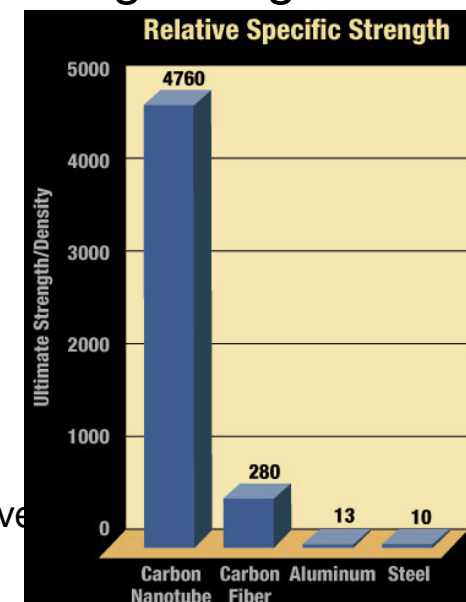
- Titanium dioxide ( $\text{TiO}_2$ ) crystals, only 40 nanometers in size, form a molecular machine powered by light.
- $\text{TiO}_2$  is a semiconductor charged by ultraviolet photons. When these nanoparticles are charged, powerful oxidizing agents called hydroxyl radicals are produced. These free radicals destroy airborne germs and pollutants.



# Nano-based hockey stick

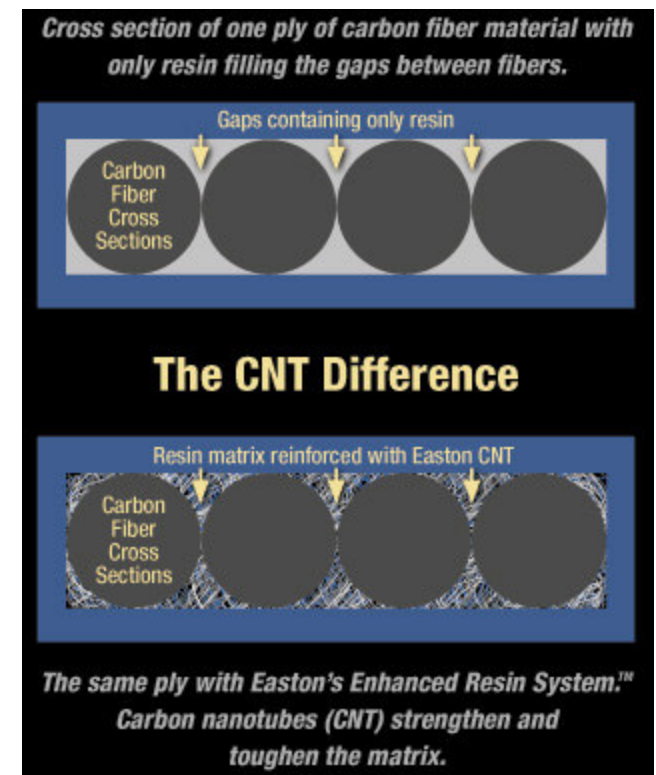
## (Montreal Sports Oy )

- The nano-based hockey stick is based on the Hybtonite carbon nano tubes, in which carbon fiber and epoxy are combined on the molecular level in a new way.
- Earlier, the carbon fiber stick was criticized in part because of the problems receiving passes with it. The new stick does not have this problem, because its flexibility allows for softer pass reception and an easier handling of the puck.
- Another benefit has to do with the shot itself. The flexibility gives better leverage, which allows the puck to be flung with greater speed
- The stick has a 60 - 70% better impact resistant than the traditional composite stick.



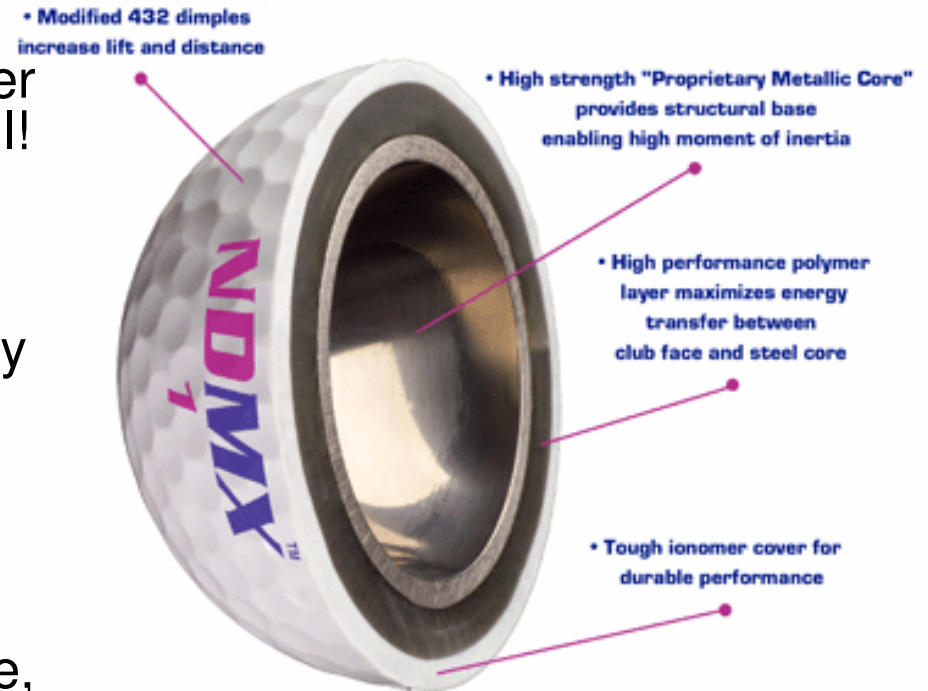
# Nanotube bike enters Tour de France (BMC, Easton, Zyvex)

- Swiss manufacturer BMC claims that the frame of its "Pro Machine" weighs less than 1 kg and has excellent stiffness and strength.
- To create the frame, BMC used a composite technology developed by US sports equipment specialist Easton: embedded carbon fibre in a resin matrix that's reinforced with carbon nanotubes. Easton says that this improves strength and toughness in the spaces between the carbon fibres.
- Zyvex supplied functionalized nanotubes that disperse more easily in other materials.
- The structure did not require machining after manufacture, avoiding damage to the carbon fibres.



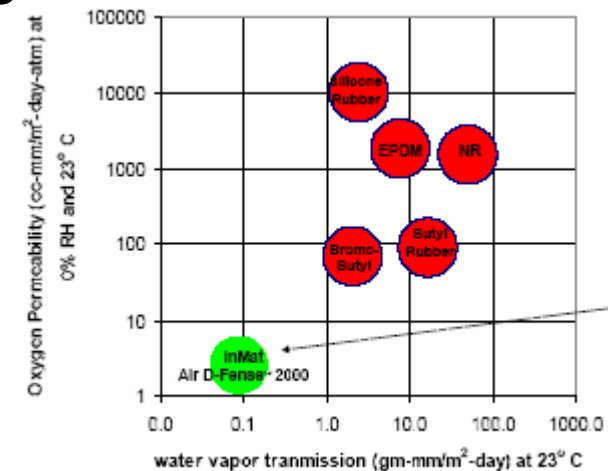
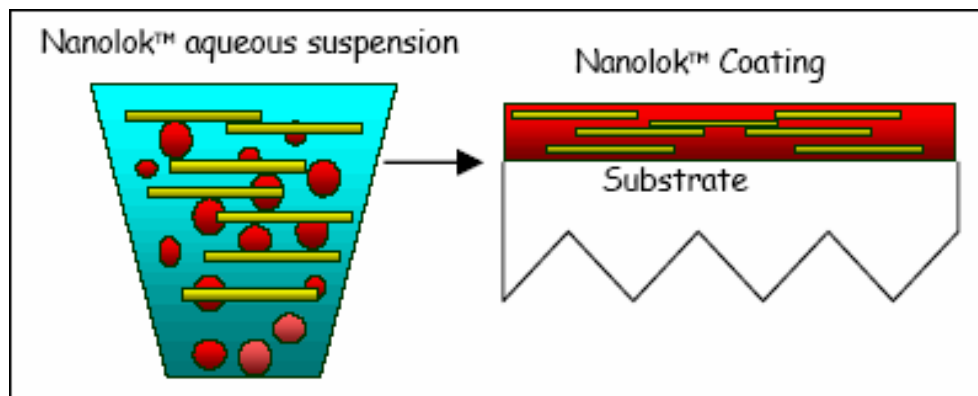
# Golf Balls (NanoDynamics)

- The NDMX HMS110 is the first-ever and only hollow metal core golf ball!
- Nano-enhanced chemistry in the ionomeric cover around a high-restitution polymerized diene core yield a firmer feel and quick velocity off the club face in this 2-piece ball designed to maximize feel and distance.
- 432 aerodynamically lift-optimizing dimples provide symmetrical flight, minimum drag for superior distance, and generate optimum trajectory for holding the green.



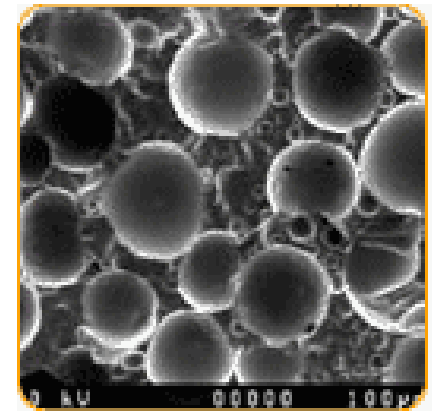
# Gloves, tennisbals (InMat)

- A aqueous suspension is applied via roll (or dip, or spray) coating process onto a rubber substrate or other substrate.
- A thin coating (10-30 microns) forms on the substrate.
- This coating contains hundreds of nanodispersed platelets per micron of coating thickness forming a tortuous path for molecules such as oxygen and aromatics, dramatically increasing the barrier properties of the substrate.



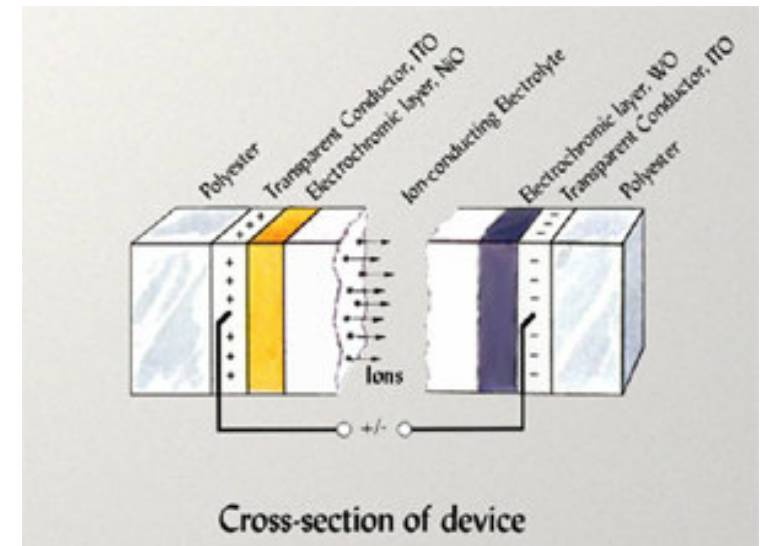
# Shock absorbing materials (Spyder/d30)

- Slalom racing suits provided to the U.S. and Canadian Olympic teams by ski wear maker Spyder contain pads from the British firm, d3o.
- It is a specially engineered material made with intelligent molecules. They flow with you as you move but on shock lock together to absorb the impact energy. When the impact is over d3o returns to being soft and flexible, this all happens in less than 100th of a second.



# Visor (Chromogenics)

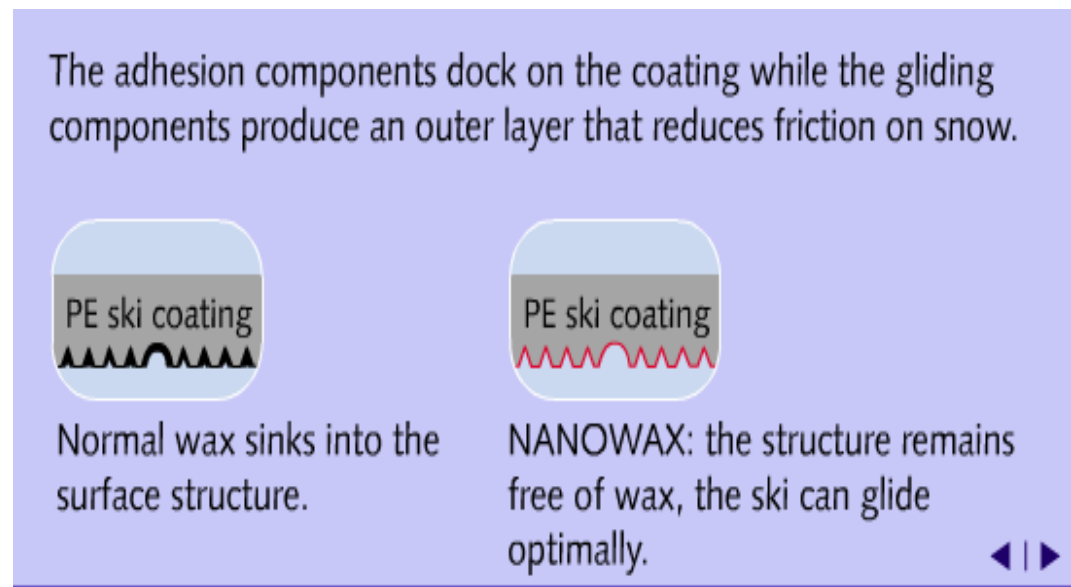
- By using a multilayer-structure comprising several different materials between two plastic films, one creates a flexible and light-weight electrochromic foil capable of changing its degree of darkness when an electrical voltage of a few volts is applied.
- The voltage drives ions from a layer of nickel oxide, via a polymer electrolyte, into a layer of tungsten oxide. Both of the oxide layers then become darker. Reversing the polarity makes the ions move in the opposite direction, and the two layers brighten.
- The rider can easily control the transparency using an electronic control unit. The visor changes between dark and light conditions in a few seconds.





# Ski-wax (Nanowax)

- The ultra thin coating changes according to the temperature and adapts to the surface and snowcrystals. The surface structure remains completely free of wax enabling optimum gliding.
- The ultra thin coating changes according to the temperature and adapts to the surface and snowcrystals. The surface structure remains completely free of wax enabling optimum gliding.
- Core function of nanowax system are the high gliding and good sticking properties. The nanoparticles in nanowax behave “intelligently”; they organize themselves on the surface automatically.
- Therefore a high amount of fluorine at the surface and uniform distribution.



# Bio/pharmaceutical

# Nano Bio



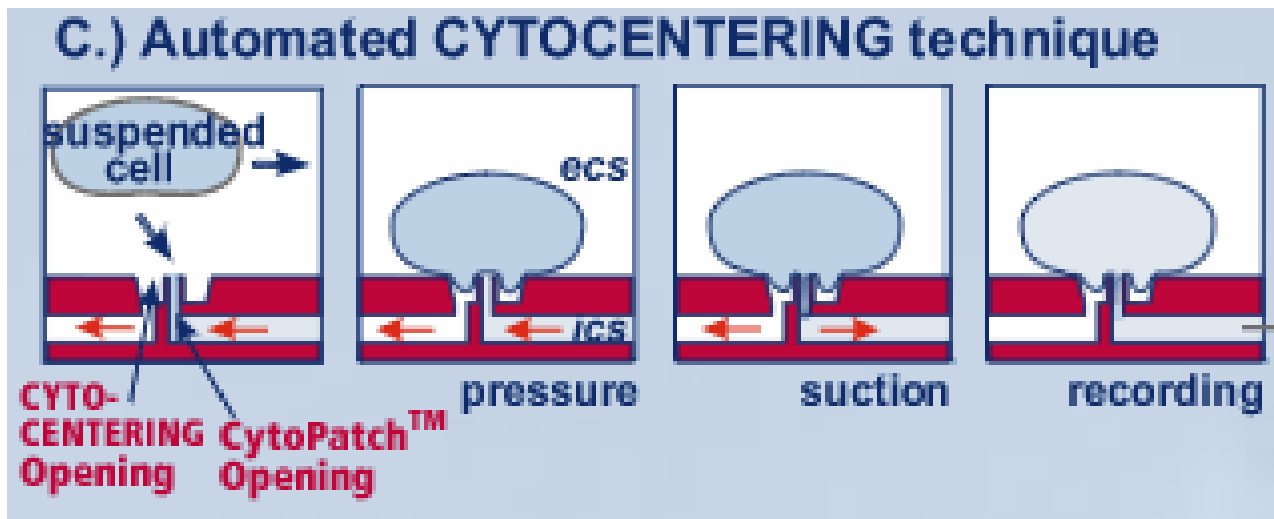
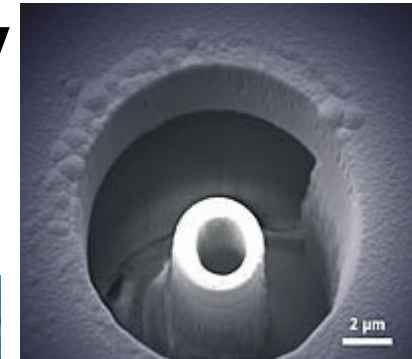
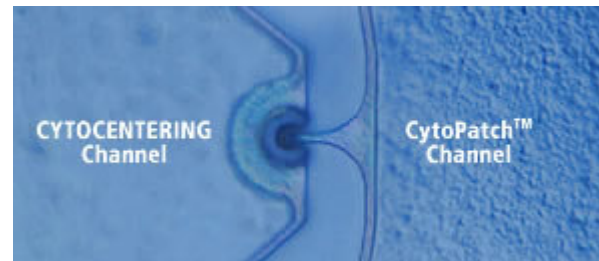
- Evolutionary and Revolutionary in nature
- Evolutionary
  - Better Pharmacology
    - Large firms will dominate
- Revolutionary
  - Cell based chips
    - Large and small firms
    - Systems

# Some market trends

- More elderly people (Europe, Usa, Japan).
- A lack of “hands on the bed” (Europe).
- More expenses on health care in developing countries.
- Diagnostics goes from central lab to “point of care”.
- Medical market starts to look like a consumer market.
- Medical market shows many overlap with market for sports attributes, food, consumers and home defence.

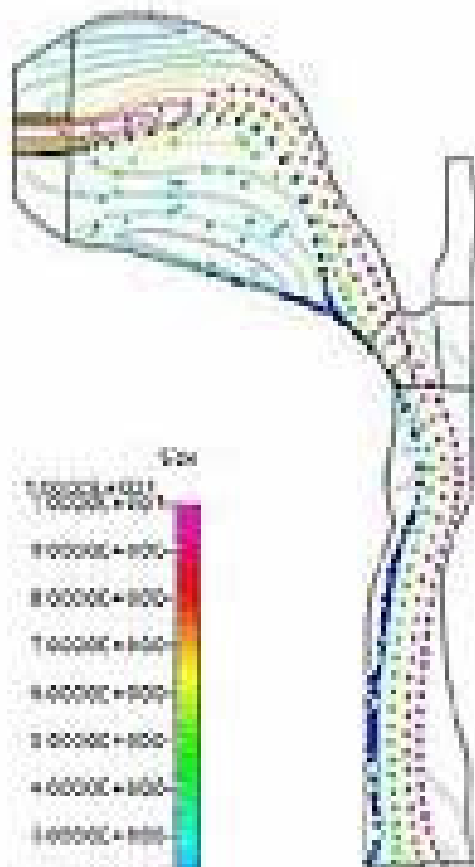
# Patchclamp technology (Cytocentrics)

Single cell analysis



In future  
leading to lab  
in chip?????

# Medspray inhaler



- Narrower droplet distribution delivery on the right place in your lungs
- Optimal effect
- And:
- small and attractive instrument

# Intelligent Toilet (Daiwa House Industry and Toto Japan)

You were very lucky your toilet called us!!



The data collected by the Intelligent Toilet is recorded, it can be uploaded via a home network and stored in a personal computer. A health management application installed on the PC uses the data to create graphs showing monthly and annual changes and even offers advice on ways to improve the user's lifestyle.



# Nanobio

- Advancements in Nanobiotechnology have an enormous potential to improve the treatment of diseases through better diagnosis, drug discovery and drug delivery.
- It has also the potential to create novel biology-inspired materials and even to develop revolutionary electronic chips that “grow” or “built themselves” based on biological molecules.

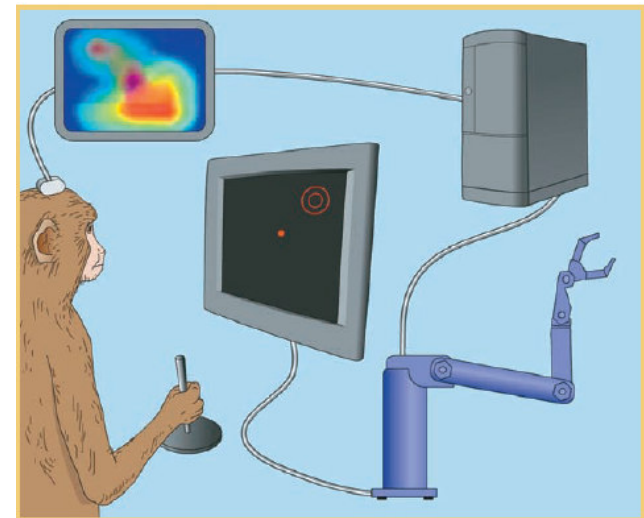
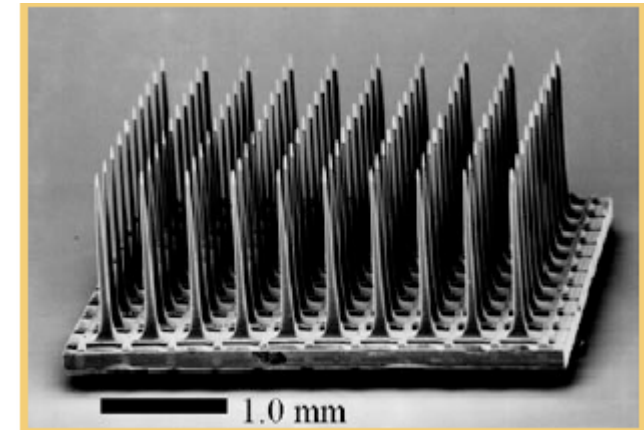
# Living electronics?

- Biological systems have been optimized through evolution and have many benefits yet to be seen in man-made systems, such as highly efficient light/energy conversion, single electron storage, and self-repairing capabilities.
- Instead of simply imitating these capabilities with electronic circuits, the integration of living cells with an electronic system provides an interesting alternative.
- The development of a good interface between electronics and organic material is necessary. Suitable interfaces must be able to immobilize living material on inorganic surfaces.
- The first issue to be overcome is bridging the gap between the structured layout of an electronic chip and the more random orientation of living matter. To achieve this, a grid pattern of cell-friendly material against a background of cell-repulsive material is deposited on the chip.
- A second issue is associated with the transfer of a signal or matter between two very different materials

# Bionic arm

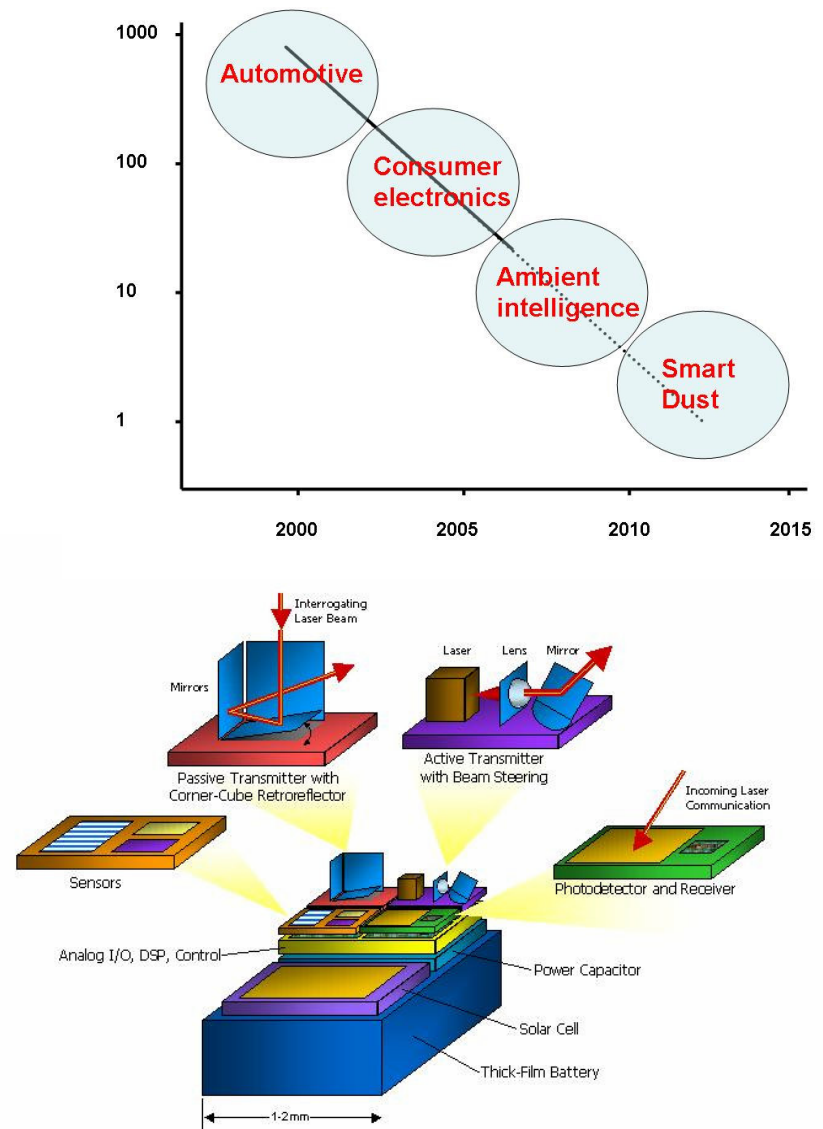
## (University of Utah/ Fraunhofer IZM )

- Aiming to develop a new prosthetic arm that would work, feel and look like a real arm.
- Focus will be on developing and testing a “peripheral nerve interface” — an implanted device that would relay nerve impulses from nerves in the residual limb to a small computer worn on a belt and then to the bionic arm.
- The person using it can sense the arm’s motion and location, and feel objects with the mechanical hand and fingers. That would allow a person to move the artificial limb like a real one.
- The neural interface device would use a pill-sized device containing 100 tiny electrodes that was developed by University of Utah.
- Fraunhofer IZM will help develop a system to supply electrical power wirelessly to the electrode array.



# Smart Dust

- Millimeter-scale self-contained MEMS devices that include sensors, computational ability, bi-directional wireless communications technology and a power supply.
- As tiny as dust particles, smart dust motes can be spread throughout buildings or into the atmosphere to collect and monitor data.
- Smart dust devices have applications in everything from military to meteorological to medical fields.



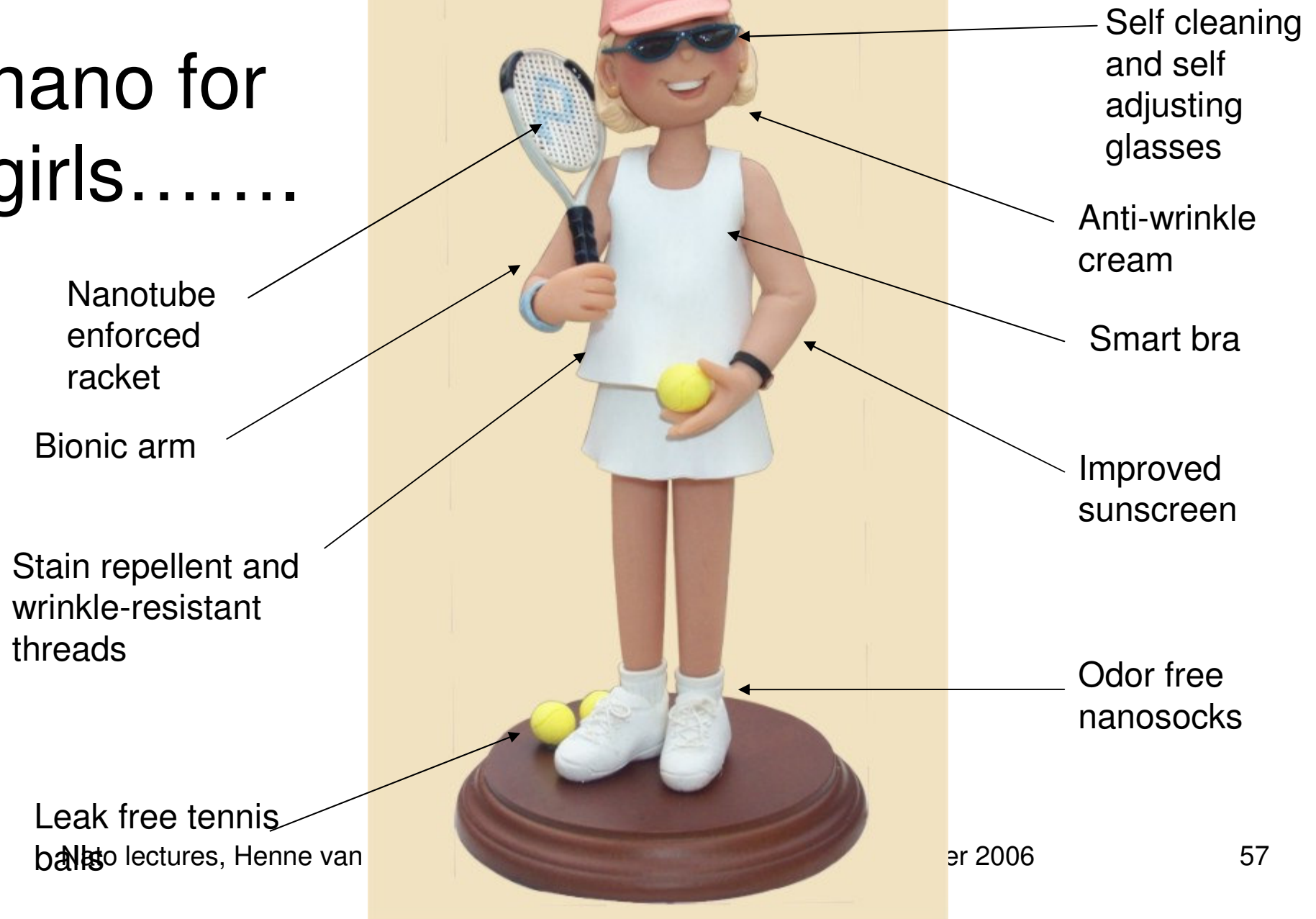
Nato lectures, Henne van Heeren, enablingMNT, nano

Sensors

# Nano materials in nanosensors

- Nano materials in nanosensors are especially suitable to detect small concentrations, applications:
  - Environmental
  - Healthcare
  - Detection of chemical or bio hazards

# Summary: nano for girls.....





# And boys!!

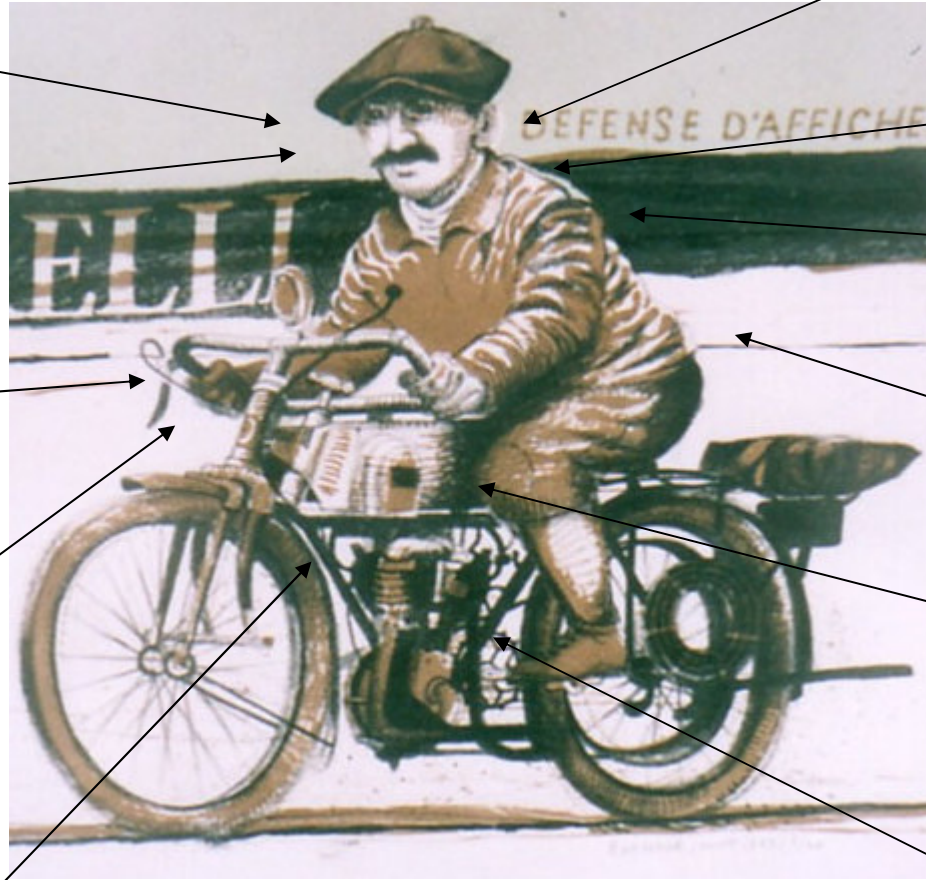
Transparency  
controlled visor

Anti dry skin

Liquid repellent  
textile

Smart vest

Self cleaning  
surface



Microvision

Smart shirt

Bodywarmer

Shockproof  
vest

Fuel  
additives

Nanosensors



General	BCC, Inc	<a href="http://www.bccresearch.com">www.bccresearch.com</a>
	Mancef	<a href="http://www.mancef.org">www.mancef.org</a>
	enablingMNT	<a href="http://www.enablingMNT.com">www.enablingMNT.com</a>
Textile	Dockers	<a href="http://www.dockers.com">www.dockers.com</a>
	Nanosphere	<a href="http://www.nanosphere-inc.com">www.nanosphere-inc.com</a>
	Invista	<a href="http://www.invista.com">www.invista.com</a>
	Nano-Tex	<a href="http://www.nano-tex.com">www.nano-tex.com</a>
	ARC Outdoors	<a href="http://www.arcoutdoors.com">www.arcoutdoors.com</a>
	Toasty Feet	<a href="http://www.toastyfeet.com">www.toastyfeet.com</a>
	JR Nanotech	<a href="http://www.jrnanotech.com">www.jrnanotech.com</a>
	Outlast technologies	<a href="http://www.outlast.com">www.outlast.com</a>
	Schoeller textiles	<a href="http://www.schoeller-textiles.com">www.schoeller-textiles.com</a>
Smart Textile	Sensatex	<a href="http://www.sensatex.com">www.sensatex.com</a>
	Vivometrics	<a href="http://www.vivometrics.com">www.vivometrics.com</a>
	NuMetrex	<a href="http://www.numetrex.com">www.numetrex.com</a>
	Isaac Daniel	<a href="http://www.isaacdaniel.com">www.isaacdaniel.com</a>
Cosmetics	L'Oreal	<a href="http://www.loreal.com">www.loreal.com</a>
	Shiseido	<a href="http://www.shiseido.com">www.shiseido.com</a>
	Advanced Nanotechnology	<a href="http://www.advancednanotechnology.com">www.advancednanotechnology.com</a>
	Oxonica	<a href="http://www.oxonica.com">www.oxonica.com</a>
	Ishizawa	<a href="http://www.ishizawa-lab.com">www.ishizawa-lab.com</a>
	Lancome	<a href="http://www.lancome.com">www.lancome.com</a>
	Isehan	<a href="http://www.isehan.info">www.isehan.info</a>
	Proctor & Gamble	<a href="http://www.pg.com">www.pg.com</a>
Self cleaning surfaces	University of Bonn	<a href="http://www.botanik.uni-bonn.de/system/planta.htm">www.botanik.uni-bonn.de/system/planta.htm</a>
	Swedish Defence	<a href="http://www.nanotek.se">www.nanotek.se</a>
Air Purification	Nanobreeze	<a href="http://www.nanobreeze.com">www.nanobreeze.com</a>
Sport	Montreal Sports Oy	<a href="http://www.montrealhockey.com">www.montrealhockey.com</a>
	BMC	<a href="http://www.bmc-racing.com">www.bmc-racing.com</a>
	Easton	<a href="http://www.eastonbike.com">www.eastonbike.com</a>
	Zyvex	<a href="http://www.zyvex.com">www.zyvex.com</a>
	NanoDynamics	<a href="http://www.nanodynamics.com">www.nanodynamics.com</a>
	inMat	<a href="http://www.inmat.com">www.inmat.com</a>
	Spyder www.	<a href="http://www.spyder.com">www.spyder.com</a>
	BMC	<a href="http://www.bmc-racing.com">www.bmc-racing.com</a>
	D3o	<a href="http://www.d3o.com">www.d3o.com</a>
	Chromogenics	<a href="http://www.chromogenics.se">www.chromogenics.se</a>
	Nanowax	<a href="http://www.nanowax.com">www.nanowax.com</a>
Bio/pharmaceutical	Cytocentrics	<a href="http://www.cytocentrics.com">www.cytocentrics.com</a>
	Medspray	<a href="http://www.medspray.com">www.medspray.com</a>
	University of Utah	
	Fraunhofer IZM	

## About enablingMNT

- The enablingMNT team utilizes its members' extensive experience and its wide network of industry contacts to offer organizations customized services in the fields of micro and nano technologies.
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- [www.enablingMNT.com](http://www.enablingMNT.com)